X-Ray Ring

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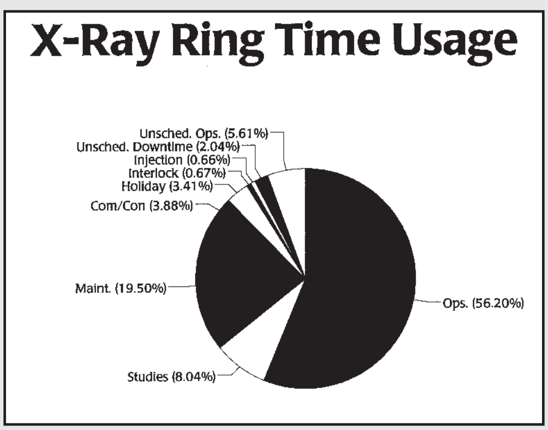
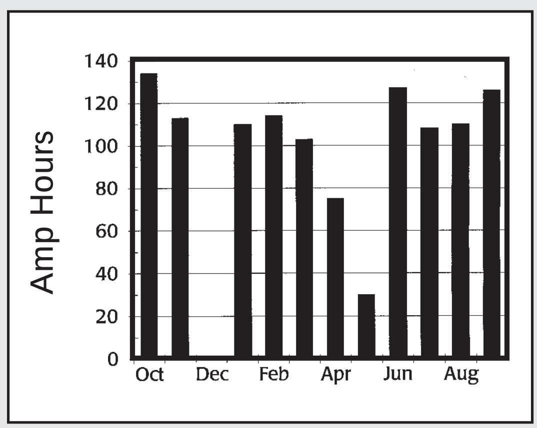
During the November 18-23, 1997, 2.8 GeV operations period and thoughout the December shutdown, there was continued progress towards completion of 2.8 GeV beamline shielding. Before the March/April 2.8 GeV operations period, studies shifts were set aside so that all lines could be approved for operation.

There was a considerable amount of work performed on various NSLS systems during the December 1997 shutdown. A primary aluminum water system heat exchanger was replaced and a plugged high pressure copper water system heat exchanger was disaasembled and cleaned. The aluminum water system control valve was rebuilt and the the three deionizer systems were relocated to make them more accessible. Additional 1 inch diameter experimental water spigots were installed at several locations on the X-ray floor. The X-Ray Ring RIA and RIB interlock chains were physically separated in new conduits running around the ring. The Critical Device Overtemperature System (CDOS) was installed in the Control Room and the installation of Klixon temperature sensors at the output of existing Proteus flow meters continued. The CDOS will dump X-ray beam if the cooling water temperatures from critical ring components (aluminum chamber, crotch, front end components, etc) exceed specified setpoints. Presently there are interlocks that will dump the ring if the global aluminum temperature exceeds 105° F or if the power supply water exceeds 115° F. Towards the goal of 438 mA operation at 2.584 GeV, new Be windows were installed on X3B, X16A, X16B, X16C, X18A, X18B, X20B, X22B, X27A and X27C. There were three Be windows that still needed to be replaced: X10B, X11A, and X22C. New safety shutters rated for operation up to 500 mA were installed in the X21 and X25 frontends. The final requirement remaining for high current operation was that a simulation



The breakdown of the X-Ray Ring usage based on total time (not scheduled time) for FY 1998.



The total integrated current for the X-Ray Ring accumulated each month for FY 1998.

and testing be completed to confirm a lifetime projection for the 10 degree crotch assembly. In preparation for the Spring 1998 shutdown, a 1.5 foot deep hole was cut through the X-ray Ring shield wall for the installation of a transmission line for a new RF cavity. The new hole was required because the RF1 and RF2 cavities have to be split to provide room for the possible future installation of another IVUN.

During the Spring 1998 shutdown, a new all-copper cavity was installed replacing the existing RF2 cavity. This system is unique, having two 125 kW amplifiers driving a hybrid combiner capable of supplying in excess of 160 kW to the cavity and beam. The original cavity and drive loop limited this power to 100 kW. A new all-copper drive loop with improved cooling and a refined window design was also installed and tested to 150 kW continuous input power. Prior to installation the cavity underwent extensive testing in the NSLS RF test room. The cavity was baked and achieved a pressure of $1x10^{-9}$ Torr while being powered to 60 kW. The new window was tested at power levels of 120-150kW. Running at 150 kW will supply another 60 kW to the beam and allow the system to run more reliably at 350 mA with three transmitters if one system trips. The cavity has also run to 65 kW, and when in operation will increase the total voltage gradient to the beam, improving reliability when operating at 2.8 GeV. The new cavity has improved cooling and superior internal surfaces which will result in better vacuum after conditioning. All higher harmonic modes were damped with antennae to levels lower than the other RF cavities. The RF resonant frequency was successfully corrected by replacing the large Helicoflex vacuum seal with a larger cross-section seal.

Another major task planned for the Spring 1998 shutdown was the installation of the new Oxford Instruments X17 superconducting wiggler. In preparation for the wiggler, a loading dock was installed outside the present location of the X17 refrigerator for the delivery of 500 liter dewars. Double doors were installed. Duct work was removed to make room for wiggler power supplies. Before the Spring shutdown, a raised steel floor was installed for the power supplies and water cooling will be hooked up to these supplies. The new wiggler installation had to be delayed due to problems encountered during acceptance tests at BNL. Two specific issues were identified as the new wiggler was being prepared for cold tests. The first problem was a leak between the helium and nitrogen vessels in the wiggler. The other defect was an electrical short. Both of these discoveries were cause for rejection. After consultation with the manufacturer, a series of electrical checks was performed in an attempt to pinpoint the electrical short and to determine if the two defects were related. At that point all agreed that repairs on site at BNL were not feasible and arrangements were made to ship the wiggler back to the UK for further evaluation and repair.

The X17 straight section chamber downstream of the wiggler was replaced during the Spring shutdown because a water-to-vacuum leak had developed in the cooling channel in the horizontal “speed bump”, which protects X17 front end components from excessive thermal loading. The leak first started November 21, 1997, and climbed into the $5x10^{-7}$ Torr region in December 1997. When the water pumps were turned back on at the end of December, a large leak opened up. In order to resume operations on schedule in January, the chamber was baked out and a pump installed on the water channel to keep it evacuated during ring operation. Because there was no water cooling, the wiggler had to be turned off until after the chamber replacement occurred.

The beryllium window replacement program, which was begun in the Winter 96 shutdown, was completed during the Spring shutdown. During this time, the upstream-most beryllium windows in beamlines X-10B, X11A and X22C were replaced, bringing the total number of beamlines upgraded to 38. Consequently, all NSLS X-ray beamlines became compatible with ring operation up to and including 438 mAmps at 2.584 GeV or 300 mAmps at 2.8 GeV.

There were a number of interlock tasks completed during the Spring 98 shutdown. The X14A beamline security system was converted from a Phase I system to a PhaseII modular system and a Phase II system was installed on the new X14B beamline. Fast valve electronics were installed for the X10, X13, X14, X15, X16, and X23 front ends. To render these systems operational, their logic systems will be modified (so the X-ray Ring will dump if they trip) or molybdenum fast valve blades will be installed. The installation of cables for the Critical Device Overtemperature System (CDOS) took place bringing this system closer to completion. X-ray Ring tunnel emergency stops were inspected and rewired where required.

A number of electrical power distribution tasks were also completed during this shutdown. A power panel (SP8) inside the ring was moved to a more accessible location. When the last panel is moved during the upcoming Winter shutdown, all power panels inside the ring will have been relocated. Emergency power was hooked up to X-ray, UV and Booster micros, to back up the existing UPS systems, and to the Biology Cold Rooms.

The deionizer pumps for the NSLS machine water systems were moved to a more accessible location. New hosing and proteus units were installed on different water-cooled X-ray Ring components, as a part of the maintenance program.

After the Spring shutdown, commissioning of the X-Ray Ring went smoothly. The new RF system parameters were adjusted to restore routine injection to 350 mA. The X17 Active Interlock sytem was recertified for the new X17 chamber PUEs downstream of the wiggler. The chamber conditioned rapidly with the wiggler at 4.7 Tesla.

To track the horizontal motion of the X-ray ring chambers , sensor stands will be installed and data acquired during operations from high sensitivity LVDT probes mounted on the stands at various PUE locations. Ultimately, data acquired from the horizontal sensors measuring the ring chamber motion at each of the 48 PUEs during X-ray fills, will be input to the digital feedback system to correct for this motion. Carbon fiber tubes for the sensor stands arrived in March 1998. Prototype stands were built and tested for thermal stability.

Studies of the low emittance lattice indicated that additional sextupole strength was required to operate with the low emittance lattice at 2.8 GeV. Operations with the low emittance lattice commenced on September 1998 at 2.584 GeV. ■